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Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

Office Action Summary	Application No.	Applicant(s)
	09/326,422	NAYAR ET AL.
	Examiner	Art Unit
	Aung S. Moe	2612

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *29 January 2004*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-64* is/are pending in the application.

4a) Of the above claim(s) *15,16,22-34 and 54-64* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-3,7,14,17-21,35,36,43,44 and 51-53* is/are rejected.

7)☒ Claim(s) *4-6,8-13,37-42,49 and 50* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Response to Arguments

1. Applicant's arguments, see pages 20-21, filed 1/29/2004, with respect to claims rejection under 35 U.S.C. 112 and the objection to the specification have been fully considered and are persuasive. The rejection of claims under 35 U.S.C. 122 and the objection to the specification as set forth in the previous Office Action (paper no. 7) has been withdrawn.

2. Applicant's arguments with respect to the rejections under 102/103 as filed on January 29, 2004 have been fully considered but they are not persuasive.

Claim Rejections – *35 USC § 102*

As for claim 35, the Applicant alleged that "Mann '793 does not disclose or suggest the use of an array of light sensing elements having a spatially varying photosensitivities" as defined by claim 35.

In response, the Examiner respectfully disagrees because Mann '793 clearly shows in Fig. 8 that the image source (202) contains either **a still video camera** or a digital scanner to provide the images to store at the memory 210. Further, Mann '793 stated in col. 2, lines 40+, an electronic camera (i.e., such as the still video camera) contains an array of light sensor (usually charge-coupled devices) that record the brightness levels of an observed scene and quantize these into a grid of pixels. Moreover, Mann '793 clearly shown in FIG. 1-4 a spatially varying (i.e., the non-uniform exposures presented by the non-linear curves as shown in Figs. 1-4) sensitivity characteristic of an image signal generated by the sensor array of the camera. In view of this, it is cleared that the sensor array of the camera (i.e., the camera of the element 202) must detect the

spatially varying intensity of light at image locations corresponding to the pixel locations on the sensor in order to provide a spatially varying exposure image as shown in Fig. 1-4 (i.e., see col. 6, lines 15+ and col. 8, lines 5-40). For example, as illustrated in the FIG. 2 of Mann '793 that the curves 20a-20c represent the corresponding different photosensitivity values indicative of the respective photosensitivities of the image sensor (i.e., noted the different sensitivity of the image sensor having different exposures is repeated over the detector array of the camera), thus, the light-sensing elements of the camera 202 must have respective spatially varying photosensitivies to incident light to produce the spatially varying exposure image (i.e., col. 6, lines 25+ and col. 7, lines 20). Considered the image signals captured by the image sensor array of the camera (202) as shown in Fig. 7B, the brightness level associated with each pixel represents its sensitivity, such that, the brighter pixels (i.e., noted the background of the image as shown in Fig. 7B) greater exposure to image (i.e., see Figs. 1 and 2) and darker ones (i.e., the person's shirt as shown in Fig. 7B) have lower exposure.

In view of the above, the Examiner asserts that the camera (202) of Mann '793 does in fact contain the light-sensing elements (i.e., the sensor array such as CCD sensor; see col. 2, lines 40+) having respective *spatially varying photosensitivies to incident light* (i.e., Figs. 1-4 of Mann '793 are corresponding values indicative of the respective photosensitivies of the image sensor array of camera 202 having respective spatially varying photosensitivies to incident light) as defined by claim 35, thus, Mann '793 does anticipated claim 35.

Claims 36 and 43 depend from claim 35 and are rejected over Mann '793 at least for the same reasons as discussed above for claim 35.

As for claim 44, the Applicant alleged (in page 22-23) that Mann '793 does not disclose or suggest the use of "spatially varying exposure" and further stated that Mann '793 does not disclose the use of "spatially varying exposure of a single acquired image in order to increase the dynamic range of an otherwise low dynamic range optical detector".

In response to applicant's argument that the references fail to show certain features of applicant's invention, it is noted that the features upon which applicant relies (i.e., *spatially varying exposure of a single acquired image in order to increase the dynamic range of an otherwise low dynamic range optical detector*) are not recited in the rejected claim(s). Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993).

In this case, claim 44 merely recited the steps of "exposing an image sensor comprising an array of light-sensing elements to an image of a scene using a spatially varying exposure, the image sensor sensing the spatially varying exposure image", and such limitations are clearly disclosed by Mann '793. As discussed for claim 35 above, an array of light-sensing elements (i.e., the array of CCD sensor; see col. 2, lines 40+) of the image sensor of the camera (202) is exposing to an image of a scene (i.e., noted the differently exposed image of the same scene as shown in Fig. 2) using a spatially varying exposure (i.e., the non-uniform exposure of a scene presented by the non-linear curves 10 and 20a-20c as shown in Figs. 1 & 2 clearly represent the spatially varying exposure of an image of a scene because the intensity of the light exposed to the sensor from the scene is spatially varying; see col. 5, lines 25+), the image sensor (i.e., the sensor of the camera 202) sensing the spatially varying exposure image (i.e., <u>noted from Fig. 2 that the curves 20a-20c depicts each of the same scene having non-uniform intensity</u>

distributions of an exposed image, thus, it is cleared from the non-uniform curve 20a that the sensor array of camera 202 is sensing the spatially exposure image as claimed).

Furthermore, in col. 10, lines 60+ of Mann '793 clearly disclosed that the scene (S1) as shown in Fig. 7B is sensing by the image sensor of the camera (202) to provide the spatially varying (non-uniform) exposure image since overall exposure of the image is underexposed but well-exposed for highlight image areas (i.e., noted the spatially varying intensity of light at image S1 wherein the intensity is spatially varying between the light backlit and the dark person).

In view of the above, the Examiner asserts that Mann '793 does in fact discloses the step of exposing an array of light sensing elements (i.e., the CCD array of camera 202) to an image of a scene (i.e., see Figs. 2 and 7B; col. 10, lines 60+) using a spatially varying exposure as claimed, thus, Mann '793 does anticipated claim 44.

Claim 48 depends from claim 44 and is rejected for the same reasons as discussed above for claim 48.

With respect to Tatko et al reference, the Applicant alleged that "Tatko '504 does not disclose the use of spatially varying exposure and, therefore, does not teach or suggest the subject matter set forth in claim 44."

In response, the Examiner respectfully disagrees because it is evident from Figs. 4-6 that the image sensor (18) is capable of sensing a spatially varying intensity of light on the image sensor for generating the spatially varying exposure image which contain the low gain and high gain signals (i.e., see col. 1, lines 35+ and col. 2, lines 5+). Furthermore, Tatko '504 discloses

that the sensor 18 outputs a corresponding low gain signal (28) and a high gain signal (30) which are available simultaneously at the output of the demultiplexer (26) (i.e., col. 3, lines 40+ and col. 5, lines 17+), thus, the sensor 18 clearly introduces a spatially varying exposure (i.e., noted from the intensity distribution of the image as shown in Figs. 4 and 5 that the image sensor 18 sensing the spatially varying exposure image) and providing a saturated pixel value (i.e., High Gain value) and a blackened pixel value (i.e., Low Gain value) respectively based on the first and second threshold levels (col. 5, lines 15+); and normalizing (42) the pixel values provided by the image sensor (18) with respect to the spatially varying exposure (i.e., noted the non-uniform response of the image sensor as shown in Figs. 4-5) of the light-sensing elements (i.e., the CCD array sensor as discussed in col. 3, lines 10+) to derive corresponding normalized pixel values (i.e., see Fig. 1, col. 5, lines 64+) as set forth in claim 44.

In view of the above, it is cleared that the sensitivity of the pixels of the sensor 18, such as CCD sensor, can be preset by using different integration times for different pixels (i.e., noted the controller 19), or by embedding different apertures (i.e., noted the attenuator 14) for the potential wells of pixels. All these implementation result in the same effect, namely, a detector array (i.e., the CCD sensor array as discussed in col. 3, lines 10+) with spatially varying exposures as shown in Figs. 4-5, thus, Tatko '504 does anticipated claim 44.

Regarding claim 51, it is noted that claim 51 depends from claims 44 and is anticipated by Tatko '504 at least for the reasons discussed above.

Claim Rejections – *35 USC § 103*

Applicant's arguments with respect to claims 1-3, 7, 14, and 17-20 have been considered but are moot in view of the new ground(s) of rejection.

Regarding claims 1 and 21, the applicant alleged (in page 25 of the remarks) that "Burger does not address the claimed subject matter of increasing dynamic range of an image sensor. Accordingly, Burger does not address the shortcomings noted above with respect to the Mann patent as applied to claim 1."

In response to applicant's arguments against the references individually, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986). In this case, it is noted that the subject matter of increasing dynamic range of an image sensor is clearly disclosed by Mann '793 (i.e., as discussed in col. 2, lines 40+ and col. 3, lines 60+ that the object of Mann '793 is to expand the dynamic range of the source image scene, thus, the source image generated by the image sensor having a low dynamic range relative to the range of light intensities). Accordingly, a Burger'974 reference is used to show the use of mask (noted the mask as shown in Figs. 2, 16A, 18 and 19) between the scene and the array of light-sensing elements (i.e., col. 27, lines 55-60 and col. 28, lines 40-45).

In particular, Burger '974 teaches the use of a mask with the light-sensing element (Figs. 2, 16A and 18-19; col. 20, lines 5+ and col. 27, lines 45+) wherein the mask interposed between the scene and the array of light-sensing elements (i.e., see Figs. 2, 16A, 18-22 and 27) of the

image sensor (i.e., the CCD sensor), the mask having a multiplicity of light-transmitting cells each controlling the exposure of a respective one or more of the light-sensing elements to light from the scene to provide spatially varying exposure to the array of light sensing elements (i.e., noted from Fig. 19 that the optical mask 350 provides the spatially varying exposure to the array of light sensing elements 356), each of the light-sensing elements having a corresponding exposure value indicative of the transparency of the cell through which light impinging on the light-sensing element passes (i.e., as shown in Figs. 16A, 18-19, the respective one of the sensor is exposed by the light which is controlled by the multiplicity of light-transmitting cells of the masks; see col. 27, lines 5-col. 28, lines 20+) as recited in present claimed invention.

Therefore, having the system of Mann '793 and then given the well-established teaching of Burger '974, the Examiner continues to be of the opinion that one skilled in the art would have been prompted to combine the cited references, since Burger '974 state at col. 32, lines 30+ that such a modification would provide a stable, monolithic structure for easy integration into a system to improve the image quality or modulation transfer function thereof.

In view of the above, the combination of Mann '793 and Burger '974 does in fact disclose the present claimed invention as recited in claim 1.

Claim 21 depends form clam 1 and is rejected for the same reason as discussed above.

Regarding clams 45-47 and 52, the Applicant alleged (in page 26 of the remarks) that "the mask referred to in Laroche '322 is a well known Bayer geometry mask for color separation.

The Bayer mask does not achieve spatially varying exposure to increase dynamic range as set forth in the present claims."

In response to applicant's argument that the references fail to show certain features of applicant's invention, it is noted that the features upon which applicant relies (i.e., "achieve spatially varying exposure to increase dynamic range") are not recited in the rejected claim(s). Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993).

In this case, Laroche '322 clearly teaches in col. 1, lines 10-25 that it is conventionally well known to use the mask in a single-sensor camera for detecting the spatially varying intensity of light at image locations corresponding to a regular pattern of pixel locations on the sensor. In view of this, the combination of Mann '793 and Laroche '322 does in fact show the step of exposing the image sensor using a spatially varying exposure (i.e., please see the Examiner's comments with respect to claim 44 as discussed above) includes the step of using a mask (i.e., noted the mask of Laroche '322 as shown in Figs. 1, 3 and 4) having a multiplicity of light transmitting cells each controlling the exposure of a respective one or more of the light-sensing elements (i.e., noted the R, G and B light-sensing elements of Laroche '322) of the image sensor (i.e., the sensor of the camera as shown in both Mann '793 and Laroche '322) to light from the scene, each of the light-sensing element having a corresponding exposure value indicative of the transparency of the mask cell (i.e., Figs. 3 and 4 of Laroche '322) through which light impinging on the light-sensing element passes (col. 3, lines 1-68)" as recited in the present claimed invention. Therefore, the Examiner continues to be of the opinion that one skilled in the art

would have been prompted to combine the cited references, since Laroche '322 state at col. 1, lines 65+ that such a modification would reduce color edge artifacts and improve image sharpness, without unduly increasing cost and complexity thereof.

In view of the above, the combination of Mann '793 and Laroche '322 does in fact disclose the present claimed invention as recited in claim 44-45.

Claims 46-47 and 52 depends form clam 45 and is rejected for the same reason as discussed above.

In view of the above discussion, the present claimed invention is rejected as follows:

Claim Rejections - 35 USC § 102

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

The changes made to 35 U.S.C. 102(e) by the American Inventors Protection Act of 1999 (AIPA) and the Intellectual Property and High Technology Technical Amendments Act of 2002 do not apply when the reference is a U.S. patent resulting directly or indirectly from an international application filed before November 29, 2000. Therefore, the prior art date of the reference is determined under 35 U.S.C. 102(e) prior to the amendment by the AIPA (pre-AIPA 35 U.S.C. 102(e)).

4. Claims 35-36, 43, 44 and 48 are rejected under 35 U.S.C. 102(e) as being anticipated by Mann (U.S. 5,828,793).

Regarding claim 35, Mann '793 discloses a system for high dynamic range imaging comprising: an image sensor (i.e., CCD sensor; col. 2, lines 40+) comprising an array of light-sensing elements (i.e., col. 12, lines 30+), the image sensor sensing an image of a scene and providing corresponding pixel values representing light intensities impinging on respective one of the light-sensing elements (i.e., as discussed and shown in Figs. 1-4, 7B and 8 that an image source 202 contains an array of light-sensing elements, e.g., CCD sensor, and further, providing a spatially varying exposure image; see col. 2, lines 40+), each light-sensing element having a respective first threshold level so as to cause the image sensor to provide a saturated pixel value when the intensity of light impinging on the light-sensing element is greater than the respective first threshold level (i.e., see Figs. 1-4 and 7B; noted from Fig. 1 that lighter image with a saturated pixel value is provide when the intensity of light impinging on the image sensor is greater than, e.g., above, a maximum density threshold level; see col. 4, line 50-col. 5, lines 1+; col. 6, lines 30+; col. 7, lines 20+ and col. 11, lines 30+), each light-sensing element having a respective second threshold value so as to cause the image sensor to provide a blackened pixel value when the intensity of light impinging on the light-sensing element is below the respective second threshold level (i.e., noted from Fig. 1 that darker image with a blackened pixel value is provide when the intensity of light impinging on the image sensor is below a minimum density threshold level; see col. 4, lines 50 – col. 5, lines 1_; col. 6, lines 30+, col. 7, lines 20+ and col. 11, lines 30+), the image sensor having a low dynamic range relative to the range of light intensities of the image of the scene (i.e., as discussed in col. 2, lines 40+ and col. 3, lines 60+

that the object of Mann '793 is to expand the dynamic range of the source image scene, thus, the source image generated by the image sensor having a low dynamic range relative to the range of light intensities), the light-sensing elements having respective spatially varying photosensitivies to incident light and corresponding photosensitivity values indicative of the respective photosensitivities (i.e., noted the photosensitivity values indicative of the respective photosensitivities as shown in Figs. 1-4 and 7B; see col. 4, lines 45-col. 5, lines 48),

a first memory (i.e., Fig. 8, the element's 210; see col. 12, lines 35+) storing photosensitivity values corresponding to each of the light-sensing element; and

an image processor (i.e., Fig. 8, the elements' 220 and 240; see col. 12, lines 1+) coupled to the array of light-sensing elements for receiving the pixel values provided by the image sensor (i.e., noted the image source 202 having a CCD array sensor for providing the pixel values) and coupled to the first memory (i.e., Fig. 8, the element's 210) for receiving the photosensitivity values corresponding to the light-sensing elements (i.e., noted the photosensitivity values of the source image S1, S2 and S3, respectively), the image processor comprising a normalizer for mapping the pixel values by a function of photosensitivity values to derive corresponding normalized pixel values (i.e., noted that the combiner 246 and the analyzer 243 is capable mapping the pixel values by a function of photosensitivity values to derive respective normalized pixel values; see col. 8, lines 5-10 and col. 12, lines 30+), and an interpolator for interpolating the normalized pixel values to derive interpolated pixel values at respective positions of a secondary array overlapping the array of light-sensing elements (i.e., noted that the filter 255 is capable of interpolating the normalized values respectively by

overlapping the different array of pixels values of the source images; see Figs. 7A-7B; col. 10, lines 20+, col. 11, lines 5+ and col. 12, lines 30+).

Regarding claim 36, Mann '793 discloses wherein the normalizer of the image processor maps the pixel values by a function of the photosensitivity values by dividing each of the pixel values by the photosensitivity value corresponding to the light-sensing element receiving light intensity represented by the pixel value (i.e., see col. 7, lines 45 – col. 8, lines 20+).

Regarding claim 43, Mann '793 discloses an output image memory (i.e., Fig. 8, the elements 208 and 250) coupled to the image processor (i.e., Fig. 8, the elements' 220/210) for receiving and storing the interpolated pixel values.

Regarding claim 44, Mann '793 discloses a method for high dynamic range imaging comprising the steps of:

exposing an image sensor comprising an array of light-sensing elements to an image of a scene using a spatially varying exposure (i.e., as discussed and shown in Figs. 1-4 , 7B and 8 that an image source 202 contains an array of light-sensing elements, e.g., CCD sensor, and further, providing a spatially varying exposure image; see col. 2, lines 40+), the image sensor (i.e., the sensor of the image source 202) sensing the spatially varying exposure image and providing corresponding pixel values representing light intensities impinging on respective one of the light-sensing elements (i.e., see Figs. 1-4 and 7B; col. 1, lines 15+, col. 2, lines 46+, col. 5, lines 1+ and col. 6, lines 25+), the image sensor (i.e., col. 2, lines 40+) providing a saturated pixel value when the intensity of light impinging on a corresponding one of the light-sensing elements is greater than a first threshold level (i.e., see Figs. 1-4 and 7B; noted from Fig. 1 that lighter image with a saturated pixel value is provide when the intensity of light impinging on the image

sensor is greater than, e.g., above, a maximum density threshold level; see col. 4, line 50-col. 5, lines 1+; col. 6, lines 30+; col. 7, lines 20+ and col. 11, lines 30+) and providing a blackened pixel value when the intensity of the light impinging on a corresponding one of the light-sensing elements is below a second threshold level (i.e., noted from Fig. 1 that darker image with a blackened pixel value is provide when the intensity of light impinging on the image sensor is below a minimum density threshold level; see col. 4, lines 50 – col. 5, lines 1_; col. 6, lines 30+, col. 7, lines 20+ and col. 11, lines 30+), the image sensor having a low dynamic range relative to the range of light intensities of the image of the scene (i.e., as discussed in col. 2, lines 40+ and col. 3, lines 60+ that the object of Mann '793 is to expand the dynamic range of the source image scene, thus, the source image generated by the image sensor having a low dynamic range relative to the range of light intensities); and

normalizing the pixel value provided by the image sensor with respect to the spatially varying exposure of the light-sensing elements to derive corresponding normalized pixel values (i.e., see Figs. 1-7B; col. 7, lines 15-col. 8, lines 7+).

Regarding claim 48, Mann '793 discloses wherein the step of interpolating the normalized pixel values include the step of applying an interpolation filter (i.e., noted the filter 255 as shown in Fig. 8) to the normalized pixel values (i.e., as discussed in col. 10, lines 20+ that the step of interpolating is applied to the normalized pixel values respectively; see Figs. 7A-7B).

5. Claims 44 and 51 are rejected under 35 U.S.C. 102(e) as being anticipated by Tatko et al. (U.S. 6,501,504).

Regarding claim 44, Tatko '504 discloses a method for high dynamic range imaging comprising the steps of:

exposing an image sensor comprising an array of light-sensing elements to an image of a scene using a spatially varying exposure (i.e., as discussed and shown in Figs. 1-6 that an image sensor 18 contains an array of light-sensing elements, e.g., CCD sensor, and further, providing a spatially varying exposure image; see col. 3, lines 4+), the image sensor (i.e., the sensor 18) sensing the spatially varying exposure image and providing corresponding pixel values representing light intensities impinging on respective one of the light-sensing elements (i.e., see Figs. 1 and 4-5; col. 1, lines 20+, col. 2, lines 4+, col. 3, lines 1+), the image sensor (i.e., the CCD 18) providing a saturated pixel value (i.e., High Gain value) when the intensity of light impinging on a corresponding one of the light-sensing elements is greater than a first threshold level (i.e., see Figs. 1-2A and 5; noted from Figs. 1/3A that lighter image with a saturated pixel value, e.g., the high gain value, is provide when the intensity of light impinging on the image sensor is greater than a first threshold level HTHR1; see col. 5, line 15+) and providing a blackened pixel value (i.e., Low Gain Value) when the intensity of the light impinging on a corresponding one of the light-sensing elements is below a second threshold level (i.e., noted from Figs. 1/3A that darker image with a blackened pixel value, e.g., Low Gain Value, is provide when the intensity of light impinging on the image sensor is below a second threshold level HTHR2; see col. 5, lines 15+), the image sensor having a low dynamic range relative to the range of light intensities of the image of the scene (i.e., as discussed in col. 1, lines 60+ that the

object of Tatko '504 is to enhance the dynamic range of the source image scene, thus, the source image generated by the image sensor 18 having a low dynamic range relative to the range of light intensities); and

normalizing (Fig. 1, the element 42) the pixel value provided by the image sensor with respect to the spatially varying exposure of the light-sensing elements to derive corresponding normalized pixel values (i.e., see Fig. 1; col. 5, lines 65+).

Regarding claim 51, Tatko '504 discloses the step of calibrating the pixel values provided by the image sensor (18) according to a response function of the image sensor to derive liner response pixel values (i.e., noted that the algorithm used by the combiner 32 is a linear combination wherein the composite image signals 40 is provided to the normalizer 42 for performing the normalization process; see col. 4, lines 25+) before the step of normalizing the pixel value (i.e., noted the normalizer 42).

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

7. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any

evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

8. Claims 1-3, 7, 14, 17-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mann '793 in view of Laroche et al. (U.S. 5,373,322).

Regarding claim 1, Mann '793 discloses a system for high dynamic range imaging comprising: an image sensor (i.e., CCD sensor; col. 2, lines 40+) comprising an array of light-sensing elements (i.e., col. 12, lines 30+), the image sensor sensing an image of a scene and providing corresponding pixel values representing light intensities impinging on respective one of the light-sensing elements (i.e., as discussed and shown in Figs. 1-4 , 7B and 8 that an image source 202 contains an array of light-sensing elements, e.g., CCD sensor, and further, providing a spatially varying exposure image; see col. 2, lines 40+), each light-sensing element having a respective first threshold level so as to cause the image sensor to provide a saturated pixel value when the intensity of light impinging on the light-sensing element is greater than the respective first threshold level (i.e., see Figs. 1-4 and 7B; noted from Fig. 1 that lighter image with a saturated pixel value is provide when the intensity of light impinging on the image sensor is greater than, e.g., above, a maximum density threshold level; see col. 4, line 50-col. 5, lines 1+; col. 6, lines 30+; col. 7, lines 20+ and col. 11, lines 30+), each light-sensing element having a respective second threshold value so as to cause the image sensor to provide a blackened pixel

value when the intensity of light impinging on the light-sensing element is below the respective second threshold level (i.e., noted from Fig. 1 that darker image with a blackened pixel value is provide when the intensity of light impinging on the image sensor is below a minimum density threshold level; see col. 4, lines 50 – col. 5, lines 1_; col. 6, lines 30+, col. 7, lines 20+ and col. 11, lines 30+), the image sensor having a low dynamic range relative to the range of light intensities of the image of the scene (i.e., as discussed in col. 2, lines 40+ and col. 3, lines 60+ that the object of Mann '793 is to expand the dynamic range of the source image scene, thus, the source image generated by the image sensor having a low dynamic range relative to the range of light intensities), a first memory (i.e., Fig. 8, the element's 210; see col. 12, lines 35+) storing photosensitivity values corresponding to each of the light-sensing element; and

an image processor (i.e., Fig. 8, the elements' 220 and 240; see col. 12, lines 1+) coupled to the array of light-sensing elements for receiving the pixel values provided thereby (i.e., noted the image source 202 having a CCD array sensor for providing the pixel values) and coupled to the first memory (i.e., Fig. 8, the element's 210) for receiving the photosensitivity values corresponding to the pixel value (i.e., noted the photosensitivity values of the source image S1, S2 and S3, respectively), the image processor comprising a normalizer for mapping the pixel values by a function of photosensitivity values to derive corresponding normalized pixel values (i.e., noted that the combiner 246 and the analyzer 243 is capable mapping the pixel values by a function of photosensitivity values to derive respective normalized pixel values; see col. 8, lines 5-10 and col. 12, lines 30+).

Furthermore, although Mann '793 discloses the use of a mask for controlling the exposure of a sensor (i.e., see col. 13, lines 20+), Mann '793 does not explicitly states wherein "a mask

interposed between the scene and the array of light-sensing elements of the image sensor, the mask having a multiplicity of light-transmitting cells each controlling the exposure of a respective one or more of the light-sensing elements to light from the scene to provide spatially varying exposure to the array of light sensing elements, each of the light-sensing elements having a corresponding exposure value indicative of the transparency of the cell through which light impinging on the light-sensing element passes" as recited in present claimed invention.

However, the above-mentioned claimed limitations are well known in the art as evidenced by Laroche '322. In particular, Laroche '322 discloses the use of a mask (i.e., see Fig. 1, noted the color filter mask 13 having a respective light transmitting cells each controlling the exposure of the respective color signals for the light-sensing sensor 12) interposed between the scene and the array of light-sensing elements of the image sensor (12), and the mask (13) having a multiplicity of light transmitting cells each controlling the exposure of a respective one or more of the light-sensing elements (i.e., noted from Figs. 1 and 3 that each cell of the mask 13 is capable of controlling the exposure of a respective one of the sensor) of the image sensor to light from the scene to provide spatially varying exposure (i.e., col. 1, lines 10+) to the array of light sensing elements (12), each of the light-sensing element having a corresponding exposure value indicative of the transparency of the mask cell through which light impinging on the light-sensing element passes (i.e., see Figs. 3-4; col. 3, lines 1-68)" as recited in the present claimed invention.

In view of the above, having the system of Mann '793 and then given the well-established teaching of Laroche '322, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the system of Mann '793 as taught by Laroche '322, since

Laroche '322 state at col. 1, lines 65+ that such a modification would reduce color edge artifacts and improve image sharpness, without unduly increasing cost and complexity thereof.

Regarding claim 2, the combination of Mann '793 and Laroche '322 discloses wherein the normalizer divides each of the pixel values with the exposure value corresponding to the light-sensing element receiving light intensity represented by the pixel value to derive corresponding normalized pixel values (i.e., col. 8, lines 5-10 of Mann '793 and see Fig. 2 of Laroche '322).

Regarding claim 3, the combination of Mann '793 and Laroche '322 discloses an interpolator for interpolating the normalized pixel values to derive interpolated pixel values at respective positions of a secondary array overlapping the array of light-sensing elements (i.e., noted from Figs. 8 of Mann '793 that the filter 255 is capable of interpolating the normalized values respectively by overlapping the different array of pixels values of the source images; see Figs. 7A-7B; col. 10, lines 20+, col. 11, lines 5+ and col. 12, lines 30+ of Mann '793; and Fig. 2 of Laroche '322).

Regarding claim 7, the combination of Mann '793 and Laroche '322 discloses wherein the interpolator of the image processor applies an interpolation filter to the normalized pixel values (i.e., noted the filter 255 as shown in Fig. 8 of Mann '793; see col. 10, lines 20+ of Mann '793; and Fig. 2 of Laroche '322).

Regarding claim 14, the combination of Mann '793 and Laroche '322 discloses an output image memory coupled to the image processor for receiving and storing the interpolated pixel values (i.e., noted the Storage 208 as shown in Fig. 8 of Mann '793; and Fig. 1, the section 4 of Laroche '322).

Regarding claim 17, the combination of Mann '793 and Laroche '322 discloses wherein the array of light sensing element is a solid state device image sensing device (i.e., see col. 2, lines 40+ of Mann '793; and col. 2, lines 65+ of Laroche '322).

Regarding claim 18, the combination of Mann '793 and Laroche '322 discloses wherein the solid state device is a charge-couple device light sensing array (i.e., see col. 2, lines 40+ of Mann '793; and col. 2, lines 65+ of Laroche '322).

Regarding claim 19, it is noted that the combination of Mann '793 and Laroche '322 does not show the use of a CMOS light-sensing array. However, the Examiner takes an Official Notice that the use of COMS light-sensing array, such as Active-pixel sensors, in the camera is well known in the art to alleviate readout noise and allow for a much larger image array, thus, it would have been obvious to one having ordinary skill in the art at the time the invention was made to use a well known CMOS light – sensing array in the camera system of Mann '793 to alleviate readout noise and allow for a much larger image array capable of faster charging and discharging.

Regarding claim 20, the combination of Mann '793 and Laroche '322 discloses wherein the mask is integrated with the light-sensing elements on the same substrate (i.e., see Figs. 1 and 3; col. 1, lines 14+ and col. 3, lines 1+ of Laroche '322).

9. Claims 1 and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mann '793 in view of Burger (U.S. 6,124,974).

Regarding claim 1, Mann '793 discloses a system for high dynamic range imaging comprising: an image sensor (i.e., CCD sensor; col. 2, lines 40+) comprising an array of light-

sensing elements (i.e., col. 12, lines 30+), the image sensor sensing an image of a scene and providing corresponding pixel values representing light intensities impinging on respective one of the light-sensing elements (i.e., as discussed and shown in Figs. 1-4 , 7B and 8 that an image source 202 contains an array of light-sensing elements, e.g., CCD sensor, and further, providing a spatially varying exposure image; see col. 2, lines 40+), each light-sensing element having a respective first threshold level so as to cause the image sensor to provide a saturated pixel value when the intensity of light impinging on the light-sensing element is greater than the respective first threshold level (i.e., see Figs. 1-4 and 7B; noted from Fig. 1 that lighter image with a saturated pixel value is provide when the intensity of light impinging on the image sensor is greater than, e.g., above, a maximum density threshold level; see col. 4, line 50-col. 5, lines 1+; col. 6, lines 30+; col. 7, lines 20+ and col. 11, lines 30+), each light-sensing element having a respective second threshold value so as to cause the image sensor to provide a blackened pixel value when the intensity of light impinging on the light-sensing element is below the respective second threshold level (i.e., noted from Fig. 1 that darker image with a blackened pixel value is provide when the intensity of light impinging on the image sensor is below a minimum density threshold level; see col. 4, lines 50 – col. 5, lines 1_; col. 6, lines 30+, col. 7, lines 20+ and col. 11, lines 30+), the image sensor having a low dynamic range relative to the range of light intensities of the image of the scene (i.e., as discussed in col. 2, lines 40+ and col. 3, lines 60+ that the object of Mann '793 is to expand the dynamic range of the source image scene, thus, the source image generated by the image sensor having a low dynamic range relative to the range of light intensities), a first memory (i.e., Fig. 8, the element's 210; see col. 12, lines 35+) storing photosensitivity values corresponding to each of the light-sensing element; and

an image processor (i.e., Fig. 8, the elements' 220 and 240; see col. 12, lines 1+) coupled to the array of light-sensing elements for receiving the pixel values provided thereby (i.e., noted the image source 202 having a CCD array sensor for providing the pixel values) and coupled to the first memory (i.e., Fig. 8, the element's 210) for receiving the photosensitivity values corresponding to the pixel value (i.e., noted the photosensitivity values of the source image S1, S2 and S3, respectively), the image processor comprising a normalizer for mapping the pixel values by a function of photosensitivity values to derive corresponding normalized pixel values (i.e., noted that the combiner 246 and the analyzer 243 is capable mapping the pixel values by a function of photosensitivity values to derive respective normalized pixel values; see col. 8, lines 5-10 and col. 12, lines 30+).

Furthermore, although Mann '793 discloses the use of a mask for controlling the exposure of a sensor (i.e., see col. 13, lines 20+), Mann '793 does not explicitly states wherein "a mask interposed between the scene and the array of light-sensing elements of the image sensor, the mask having a multiplicity of light-transmitting cells each controlling the exposure of a respective one or more of the light-sensing elements to light from the scene to provide spatially varying exposure to the array of light sensing elements, each of the light-sensing elements having a corresponding exposure value indicative of the transparency of the cell through which light impinging on the light-sensing element passes" as recited in present claimed invention.

However, the above-mentioned claimed limitations are well known in the art as evidenced by Burger '974. In particular, Burger '974 teaches the use of a mask with the light-sensing element (Figs. 2, 16A and 18-19; col. 20, lines 5+ and col. 27, lines 45+) wherein the mask interposed between the scene and the array of light-sensing elements (i.e., see Figs. 2, 16A,

18-22 and 27) of the image sensor (i.e., the CCD sensor), the mask having a multiplicity of light-transmitting cells each controlling the exposure of a respective one or more of the light-sensing elements to light from the scene to provide spatially varying exposure to the array of light sensing elements (i.e., noted from Fig. 19 that the mask 350 provides the spatially varying exposure to the array of light sensing elements 356), each of the light-sensing elements having a corresponding exposure value indicative of the transparency of the cell through which light impinging on the light-sensing element passes (i.e., as shown in Figs. 16A, 18-19, the respective one of the sensor is exposed by the light which is controlled by the multiplicity of light-transmitting cells of the masks; see col. 27, lines 5-col. 28, lines 20+) as recited in present claimed invention.

In view of the above, having the system of Mann '793 and then given the well-established teaching of Burger '974, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the system of Mann '793 as taught by Burger '974, since Burger '974 state at col. 32, lines 30+ that such a modification would provide a stable, monolithic structure for easy integration into a system to improve the image quality or modulation transfer function thereof.

Regarding claim 21, the combination of Mann '793 and Burger '974 discloses wherein the mask is made of a nonlinear optical material (i.e., see col. 33, lines 1-16 of Burger '974).

10. Claims 45, 46, 47 and 52-53 rejected under 35 U.S.C. 103(a) as being unpatentable over Mann '793 in view of Laroche et al. (U.S. 5,373,322).

Regarding claim 45, it is noted that although Mann '793 shows the step of exposing the image sensor (col. 2, lines 40+) using spatially varying exposure and step of normalizing the pixel values provided by the image sensor including the step of mapping the pixel values by a function of the exposure values to derive corresponding normalized pixel values (i.e., Figs. 1-4 and 7A; col. 7, lines 20-col. 8, lines 10+), Mann '793 does not explicitly show the step of using "a mask having a multiplicity of light transmitting cells each controlling the exposure of a respective one or more of the light-sensing elements of the image sensor to light from the scene, each of the light-sensing element having a corresponding exposure value indicative of the transparency of the mask cell through which light impinging on the light-sensing element passes" as recited in the present claimed invention.

However, the above-mentioned claimed limitations are well known in the art as evidenced by Laroche '322. In particular, Laroche '322 discloses the use of a mask (i.e., see Fig. 1, noted the color filter mask 13 having a respective light transmitting cells each controlling the exposure of the respective color signals for the light-sensing sensor 12) and the mask having a multiplicity of light transmitting cells each controlling the exposure of a respective one or more of the light-sensing elements (i.e., noted from Figs. 1 and 3 that each cell of the mask 13 is capable of controlling the exposure of a respective one of the sensor)of the image sensor to light from the scene, each of the light-sensing element having a corresponding exposure value indicative of the transparency of the mask cell through which light impinging on the light-sensing element passes (col. 3, lines 1-68)" as recited in the present claimed invention.

In view of the above, having the system of Mann '793 and then given the well-established teaching of Laroche '322, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the system of Mann '793 as taught by Laroche '322, since Laroche '322 state at col. 1, lines 65+ that such a modification would reduce color edge artifacts and improve image sharpness, without unduly increasing cost and complexity thereof.

Regarding claim 46, the combination of Mann '793 and Laroche '322 discloses wherein the step of mapping the pixel values by a function of the exposure values comprises dividing each of the pixel values with the exposure value corresponding to the light-sensing element receiving light intensity represented by the pixel values (i.e., see col. 7, line 45-col. 8, lines 15+ of Mann '793; and col. 6, lines 30-35+ of Laroche '322).

Regarding claim 47, the combination of Mann '793 and Laroche '322 discloses wherein the exposure values corresponding to the light-sensing elements are fixed (i.e., noted that the exposure values of the image sensor are normally fixed to the specific pixel values and this can be seen in Figs. 2 and 7B of Mann '793; also it is cleared that the exposure values of the image sensor 12 is fixed to a specific color values as shown in Fig. 1 and 3 of Laroche '322), and further comprising the step of interpolating the normalized pixel values to derive interpolated pixel values at respective position of a second array overlapping the array of the light-sensing elements (i.e., as shown in Figs. 7B of Mann '793 that during the calibration process, the normalized pixel values of the first and second array of differently exposed pixel values presented by the response curves are interpolated to determined the target pixel values thereof; see col. 8, lines 10+, col. 10, lines 10+ and col. 11, lines 10+ of Mann '793).

Regarding claim 52, the combination of Mann '793 and Laroche '322 discloses the step of storing the interpolated pixel values in an output image memory (i.e., noted form Fig. 8 of Mann '793 that the interpolated pixel values may be stored in the memory devices 250 and 208 respectively).

Regarding claim 53, the combination of Mann '793 and Laroche '322 discloses the step of projecting an image of the scene onto the mask, and projecting the image of the scene as transmitted through the mask onto the array of light-sensing elements (i.e., noted form Figs. 1 and 3 of Laroche '322 that the image of the scene must be projected onto the mask 13 by transmitting through the mask 13 onto the sensor 12).

Allowable Subject Matter

11. Claims 4-6, 8-13, 37-42 and 49-50 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Aung S. Moe whose telephone number is 703-306-3021. The examiner can normally be reached on Mon-Fri (9-5).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wendy Garber can be reached on 703-305-4929. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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